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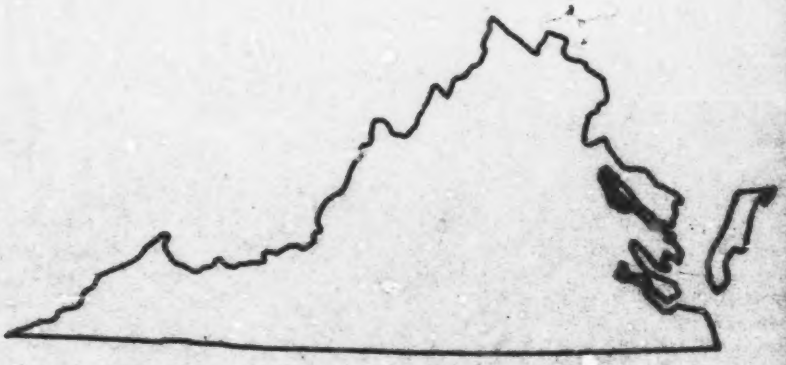
FLOOD INSURANCE STUDY

ORIGINAL

TOWN OF TAPPAHANNOCK, VIRGINIA
ESSEX COUNTY



AUGUST 4, 1987

Federal Emergency Management Agency

COMMUNITY NUMBER - 510049

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
TOWN OF TAPPAHANNOCK, ESSEX COUNTY, VIRGINIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Tappahannock, Essex County, Virginia, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic analysis for this study was prepared by the Norfolk District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement EMW-84-E-1506, Project Order No. 1, Amendment No. 20. This work was completed in January 1986.

1.3 Coordination

On August 9, 1979, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of FEMA, the town, and the Virginia State Water Control Board. At this meeting, the nature and purpose of the study and the scope and limits of work were explained, and flood information currently available concerning the community was obtained. An intermediate CCO meeting was held on February 1, 1984, to review the scope of work with the COE (the study contractor).

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Contacts with various State and Federal agencies were made during the study in order to minimize possible hydrologic conflicts. A search for basic data was made at all levels of government.

On September 18, 1986, the results of the study were reviewed at a final CCO meeting attended by representatives of FEMA, the town, the Virginia State Water Control Board, and the study contractor.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Tappahannock, Essex County, Virginia. The area of study is shown on the Vicinity Map (Figure 1).

Tidal flooding from the Rappahannock River which effects Hoskins Creek was studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through January 1991.

2.2 Community Description

The Town of Tappahannock is located on Virginia's Middle Peninsula on the south bank of the Rappahannock River, approximately 42 miles above the Chesapeake Bay. It is bordered by the Rappahannock River to the north, the York River to the south, the Chesapeake Bay to the east, and the unincorporated areas of Essex County to the west. The town has 2.75 square miles of land area with approximately 7 miles of shoreline. The 1980 population of the town was 1,821 (References 1 and 2).

Tappahannock is the county seat of Essex County and is the commercial and trading center of the region. The Downing Bridge across the Rappahannock River connects the Middle Peninsula with the Northern Neck counties to the north and affords easy access for commercial and tourist travel and trade with these counties.

The floodplains of Tappahannock consist of scattered residences, businesses, and marinas. Increased pressure for the development of the floodplains can be anticipated with future development of the area.

Temperatures in the region average 39 degrees Fahrenheit (°F) in January and 78°F in July. Precipitation is approximately 42 inches annually (Reference 1).

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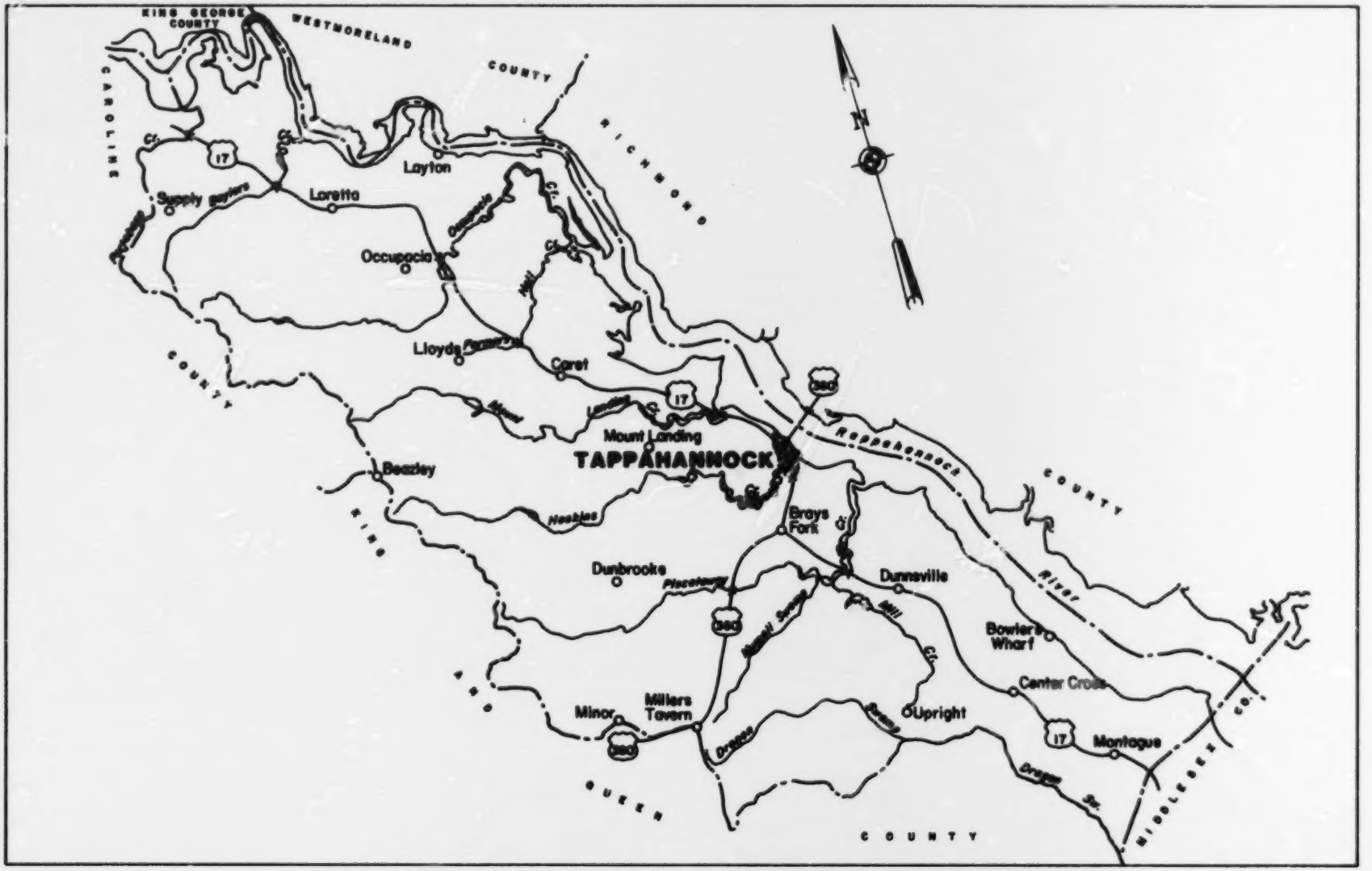

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TAPPAHANNOCK, VA.
(ESSEX COUNTY)

APPROXIMATE SCALE

0 4 8 12 MILES

VICINITY MAP

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The town lies within the Coastal Plain province, an area of gently sloping land underlain principally by sand, gravel, and clay strata. Elevations range from 0 to approximately 30 feet.

2.3 Principal Flood Problems

The coastal areas of Tappahannock are vulnerable to tidal flooding from major storms such as hurricanes and northeasters. Both types of storms produce winds that push large volumes of water against the shore.

With their high winds and heavy rainfall, hurricanes are the most severe storms that can hit the community. The term hurricane is applied to an intense cyclonic storm originating in tropical or subtropical latitudes in the Atlantic Ocean just north of the equator. While hurricanes may affect the area from May through November, nearly 80 percent occur in the months of August, September, and October, with approximately 40 percent occurring in September. The most severe hurricane to strike the community occurred in August 1933.

Another type of storm that could cause severe damage to the county is the northeaster. This is also a cyclonic type of storm and originates with little or no warning along the middle and northern Atlantic coast. These storms occur most frequently in the winter months but can occur at any time. Accompanying winds are not of hurricane force but are persistent, causing above-normal tides for long periods of time.

The amount and extent of damage caused by any tidal flood will depend on the topography of the area flooded, the rate of rise of floodwaters, the depth and duration of flooding, the exposure to wave action, and the extent to which structures have been placed in the floodplain. The depth of flooding during these storms depends on the velocity, direction, and duration of the wind; the size and depth of the body of water over which the wind is acting; and the astronomical tide. The duration of flooding depends on the duration of tide-producing forces. Floods caused by hurricanes are usually of much shorter duration than those caused by northeasters. Flooding from hurricanes rarely lasts more than one tidal cycle, while flooding from northeasters can last several days, during which the most severe flooding takes place at the time of the peak astronomical tide.

The timing or coincidence of the maximum storm surge with the normal high tide is an important factor in the consideration of flooding from tidal sources. The mean range of tide in the Rappahannock River at Tappahannock is 1.7 feet (Reference 3). Prolonged easterly or southeasterly winds tend to raise the water level in the river, while prolonged northwest winds tend to depress the water level.

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Tappahannock has experienced major storms since the early settlement of the area. Historical accounts of severe storms in the area date back several hundred years. Numerous storms of tropical origin have passed over and near the lower reaches of the Rappahannock River causing widespread damage. Although the hurricanes are very destructive, the winds are generally reduced below hurricane velocity as they pass through the area.

The hurricane of August 23, 1933, was the most destructive storm on record for this area as well as the remainder of the Chesapeake Bay region. The hurricane entered the mainland near Cape Hatteras, passed slightly west of Norfolk, and continued in a northern direction passing approximately 3 miles east of Tappahannock. The storm surge in the bay and tidal estuaries was the highest of record and coincided with the astronimical high tide. The tide at the mouth of the Rappahannock River reached 6.6 feet and 7.0 feet at Urbanna, approximately 30 miles downstream of Tappahannock.

Hurricane Hazel was the second most destructive of recent hurricanes to reach the area. Hazel entered the mainland south of Wilmington, North Carolina, during the morning of October 15, 1954, and moved rapidly northward passing over Richmond and Fredericksburg in the early afternoon. The winds were from the east and southeast until the eye passed. During this phase, the effect was greatest along the western shore of the Chesapeake Bay and the right bank of the Rappahannock River. When the eye passed, the wind shifted to the southwest with higher wind velocities and damages to the left bank. The hurricane surge was not as high as for the August 1933 hurricane or Hurricane Connie in August 1955, but the tidal surge was superimposed on the normal high tide.

During 1955, two hurricanes affected the Tappahannock area. Hurricane Connie occurred on August 12-13 and followed a path similar to that of the August 1933 hurricane. The storm passed approximately 30 miles to the east and generated a fairly high storm surge. The surge occurred at the time of the astronomical low tide in this area causing only minor damage. Hurricane Diane occurred on August 17-18, passing inland 50 miles to the east; Diane did not produce a damaging tide.

In November 1985, high winds and tides combined to play havoc with the Rappahannock River shoreline in the worst storm in decades. The storm was a product of a low pressure system that swept up the Atlantic Seaboard. Northeast winds in excess of 65 miles per hour pushed tides 5 feet above normal and battered piers, bulkheads, boats, boathouses, and other waterfront structures in Tappahannock and other areas along the Rappahannock River.

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2.4 Flood Protection Measures

There are no existing flood control structures that would provide protection during major floods in the community. There are a number of measures that have afforded some protection against flooding, including bulkheads, jetties, and non-structural measures for floodplain management such as zoning codes. The "Uniform Statewide Building Code" that went into effect in September 1973 states, "where a structure is located in a 100-Year flood plain, the lowest floor of all future construction or substantial improvement to an existing structure..., must be built at or above that level, except for non-residential structures which may be floodproofed to that level" (Reference 4). These requirments will be beneficial in reducing future flood damage in the community.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for the flooding source studied in detail affecting the community.

Tide records for Tappahannock are inadequate to establish a tide frequency relationship. The adopted tide frequency was obtained by a correlation of the tide frequency curve developed for the Norfolk Harbor

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gage (located approximately 10 miles inside the Chesapeake Bay) with available tide records and high-water marks at Gloucester Point, Virginia. There are historical accounts of tidal flooding for nearly 300 years, but a reasonably accurate indication of the heights reached in Norfolk Harbor is available only since 1908 and a complete record since 1928. The Gloucester Point gage was established in 1950.

The procedure used to develop the frequencies for Tappahannock is as follows:

a. A Norfolk Harbor statistical analysis was performed in accordance with the procedures outlined in Bulletin 17B (Reference 5). The Pearson Type III methodology without the logs was incorporated for the selected period of record from 1928 through 1978. The Pearson Type III distribution without the logs was selected as a result of the following:

   (1) A number of different distributions were fitted to tidal elevation data. The Pearson Type III distribution without the logs provided the best fit of the data points.

   (2) It was felt that a statistical analysis would produce a more reliable and reproducible result when compared to a graphical approach.

b. Consideration was given to separating hurricane and non-hurricane events. Although objective statistical approaches are available for incomplete samples (a hurricane related tide exists for less than 50 percent of the years on record), they do not always provide reasonable results. Therefore, all tropical and extratropical events were included together in the analysis of the annual maximum tides.

c. The analysis of the 51 years of systematic record indicated that the 1933 and 1936 floods could be high outliers. However, assuming that the true distribution is defined by the computed (non-adjusted) statistics, the value for the 1933 flood has an exceedence probability of 0.010. It was determined that, with 51 years of record, the probability of a flood this rare being exceeded is 40 percent. Since this risk is so high and it is known that several floods as large and possibly larger than the 1933 flood have historically occurred, the 1933 flood (and any smaller floods) was not considered to be a high outlier.

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d. Historical accounts indicate that tides have occurred in Norfolk Harbor at approximately 8 feet in 1667 and 1785 and approximately 7.9 feet in 1846. There has been a gradual rise in sea level over the investigated period of record at Norfolk Harbor. There was some question as to the amount of adjustment that should be made to the historical floods. To avoid overestimating the impact of the rise in sea level, the historical floods were increased by only 0.50 feet (approximately the same adjustment for the 1924 to 1942 period). The analysis based on a historical period of 312 years resulted in a slight move to the left of the upper portion of the frequency curve when compared to the systematic record. Since the adjustment was not very large and there is some question as to the reliability of the historical data, the COE adopted the computed statistics based on the 51 years of systematic record.

e. The lower portion of the statistical curve was adjusted with a partial duration analysis using plotting positions in accordance with Weibull (Reference 5). It included all elevations above 4.26 feet.

f. Tidal elevations were correlated between the Gloucester Harbor gage and Norfolk Harbor to determine estimated tidal heights for Tappahannock.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the Flood Insurance Rate Map (Exhibit 1); the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 2).

The stillwater elevations for the 10-, 50-, 100-, and 500-year floods have been determined for the Rappahannock River and are shown in Table 1. The tidal frequency relationship represents the combined effect of both hurricanes and northeasters on tidal flooding and reflects the random probability of surges occurring coincident with the normal astronomical tide.

TABLE 1 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
RAPPAHANNOCK RIVER				
Shoreline of Hoskins Creek within community	4.6	6.2	7.0	8.7

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Tappahannock, because of its sheltered location, is not subject to significant wave action concurrent with the 100-year storm; therefore, a wave height analysis was not performed.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. The 100-year and 500-year tidal flooding boundaries have been delineated using topographic maps a scale of of 1:7,200 with a contour interval of 10 feet (Reference 6).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 1). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zone AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

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Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

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Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

A search was made for existing literature on the flood hazards in Tappahannock. In 1978, the Virginia Institute of Marine Science (VIMS), under contract to FEMA, prepared a storm surge model for predicting storm surges along the Chesapeake Bay, both eastern and western shores (References 7 and 8). Consideration was given to these frequency studies, but they were not adopted in this report. An evaluation of the data led to conclusions that the elevations should be higher than presented.

A Flood Insurance Study for the unincorporated areas of Essex County is currently being prepared (Reference 9). The results of that study will be in complete agreement with the results of this study.

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8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Characteristics of the Population, General Population Characteristics, Virginia, Washington, D. C., August 1982.

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3. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Tide Table 1986, High and Low Water Predictions, East Coast of North and South America Including Greenland, Asheville, North Carolina, National Climatic Center, May 1985.

4. Commonwealth of Virginia, Virginia Uniform Statewide Building Code, Article 8, Part C, Section 872.6, Richmond, Virginia, September 1973.

5. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.

6. Benatec Associates of Columbus, Ohio, Topographic Maps prepared by photographic methods from U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:7,200, Contour Interval 10 Feet: Tappahannock, Virginia, 1986.

7. Virginia Institute of Marine Science, Volume I, Storm Surge Height-Frequency Analysis and Model Prediction for Chesapeake Bay, Gloucester Point, Virginia, June 1978.

8. Virginia Institute of Marine Science, Volume II, A Finite Element Storm Surge Analysis and its Application to a Bay-Ocean System, Gloucester Point, Virginia, September 1978.

9. Federal Emergency Management Agency, Flood Insurance Study, Unincorporated Areas of Essex County, Virginia (Unpublished).

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U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Intervals 5 and 10 Feet: Mount Landing, Virginia, 1968, Photorevised 1973; Tappahannock, Virginia, 1968, Photorevised 1979.

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EXHIBIT 2 - ELEVATION REFERENCE MARKS

Reference Mark	Elevation (Feet NGVD)	Description of Location
RM 1	5.807	USC&GS disk stamped R 458 1971 located approximately 0.4 mile northwest along U. S. Route 17 from junction of U. S. Route 360. Disk is set on top and in center of east concrete headwall for box culvert under U. S. Route 17.
RM 2	30.378	USC&GS disk stamped 219 MLS 1967 30 located at Tappahannock Airfield. Disk is set in top of a concrete post, 116 feet southwest of junction of State Route 700 and airfield runway; 23 feet south of State Route 700.
RM 3	22.231	USC&GS disk stamped 22.507 X 47 1934 located at north junction of U. S. Route 17 and U. S. Route 360. Disk is set in top of concrete post, 42 feet southeast of centerline of U. S. Route 360; 33 feet northeast of centerline of U. S. Route 17; and 72 feet west of west corner of Beale Memorial Baptist Church.
RM 4	4.793	USC&GS disk stamped No 4 1970 located approximately 0.2 mile east along Prince Street from intersection of U. S. Route 17. Disk is set in top of east end of concrete retaining wall at east end of Prince Street; 18 feet north of centerline of Prince Street; 26 feet southwest of power pole No. X 12748; and 61 feet north of northeast corner of Riverside Hotel.
RM 5	12.913	USC&GS disk stamped K 459 1971 located on top of north end of east concrete guard rail of U. S. Route 17 bridge over Hoskins Creek.

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